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OCEANIC ISLANDS: THEIR PHYSICAL AND  
BIOLOGICAL RELATIONS.

Synopsis of a lecture delivered

BY

ALFRED RUSSEL WALLACE.

The distinction between oceanic and continental islands was first made by Charles Darwin.

This classification, now universally accepted by scientific men, was the result of the observations and studies of Mr. Darwin on his famous voyage in the "Beagle."

Others took up and continued the work on the lines laid down by him; and a careful examination of the accounts of the early voyagers has added a great body of testimony to the soundness of the theory.

With regard to their structure, oceanic islands are volcanic, or of coral formation; and with regard to their fauna, they have no indigenous mammals and no amphibia.

The existence of these islands implies, therefore, a continuous ocean; since, if they had at any time formed part of a mainland, some representatives of the amphibia and the mammals of the continent must have kept their place on the island. The ocean has been the insuperable and

permanent barrier to the dispersion of animal forms, and there is every reason to believe that there has been no serious change in the ocean area of the globe from the very earliest days.

Mr. Darwin says on this subject ("Origin of Species," 6th ed., p. 288) :

"Looking to existing oceans, which are thrice as extensive as the land, we see them studded with many islands ; but hardly one truly oceanic island (with the exception of New Zealand, if this can be called a truly oceanic island) is as yet known to afford even a fragment of any Palæozoic or Secondary formation. Hence we may perhaps infer that during the Palæozoic and Secondary periods neither continents nor continental islands existed where our oceans now extend ; for had they existed, Palæozoic and Secondary formations would in all probability have been accumulated from sediment derived from their wear and tear ; and these would have been at least partially upheaved by the oscillations of level which must have intervened during these enormously long periods.

"If, then, we may infer any thing from these facts, we may infer that where our oceans now extend, oceans have extended from the remotest period of which we have any record ; and, on the other hand, that where continents now exist, large tracts of land have existed, subjected, no doubt, to great oscillations of level, since the Cambrian period."

I have myself said in another place that the general permanence of the continental areas cannot be doubted, but they have undergone wonderful and repeated changes in detail.

Every square mile of their surface has been again and

again under water. Lakes and inland seas have been formed, and filled up with sediment, and been subsequently raised into hills and even mountains.

Arms of the sea have existed, crossing the continent in various directions and isolating the divided portions for varying intervals.

Seas have been changed into deserts and deserts into seas. Volcanoes have grown into mountains, have been degraded and sunk beneath the ocean, have been covered with sedimentary deposits, and again raised up into mountain ranges; while other mountains have been formed by the upraised coral reefs of inland seas. The mountains of one period have disappeared by denudation or subsidence, while the mountains of the succeeding period have been rising from beneath the waves. The valleys, the ravines, and the mountain peaks have been carved out and filled up again; and all the vegetable forms which clothe the earth and furnish food for the various classes of animals have been completely changed again and again. All these changes, however, have taken place within the continental areas, substantially the same as they now are.

There is nothing to show that other continents have existed in any part of what is now the ocean. The very extended and careful soundings made in the great oceans, and most of all those made but recently by the "Challenger" expedition, have proved beyond question that the waves roll everywhere over a floor surprisingly uniform and regular, and more level in many places than the most level prairie.

There is one distinction to be made here. Outside of the shore-line of the continents, there extends beneath the

surface of the waters, for distances varying between 50 and 150 miles, a sloping base or pedestal of the continental mass. The outer edge of this base, the true limit of the continent, is known as the thousand-fathom line ; and it marks the beginning of the ocean. Islands that lie within this line are continental islands. These are of ancient or of recent formation, the former being generally divided from the mainland by a greater depth of water.

Where the continent comes to an end at the thousand-fathom line, the ocean suddenly deepens to two or three miles.

The continental islands, still attached as they are to the base of the mainland, are to all intents and purposes a portion of the continent, as well in structure as in the forms of animal and vegetable life which they afford. It is in the oceanic islands that we should meet with limited and peculiar types.

The first group that we are to examine is the collection known as the Bermuda Islands. These islands, or islets, for they are very small, number about one hundred, with a total area of not more than fifty square miles. They are composed of coral and coral-sand, hardened into rock ; they are but little elevated above the ocean, and they are surrounded by reefs, some at a distance of thirty miles from the main group. Immediately beyond these reefs the ocean is very deep, soundings in four directions showing 2,500 fathoms.

Captain Nares, of the "Challenger," in his report, speaks of Bermuda as a "solitary peak rising abruptly from a base only 120 miles in diameter."

These islands may, therefore, be regarded as typically oceanic.

They are situated in 32° N. Lat., at a distance of 700 miles from the continent.\*

There are in the islands no indigenous land mammals, no frogs, and no snakes; and there is but one species of lizard.

There are in all 180 species of birds known in the group; but of these only ten are resident, and one of these, the English sparrow, has been introduced by man. More than half of the whole number of species consists of waders and swimmers, and about 85 are land birds which, it might be thought, could hardly fly so far. Most of these birds are migratory, and all are American.

It is well known that North America possesses a greater number of migratory birds than any other continent, because of its variable climate and great extremes of temperature. These meteorological conditions give rise to sudden and violent storms, and these, blowing from the land, catch and carry out to sea the birds on their periodical journeys to the north and to the south. Immense numbers of these birds must perish every year, when swept out in this way on the stormy Atlantic, and those that find refuge on the little group of the Bermudas are comparatively few.

This continual accession of new individuals has kept the birds of these islands from developing any distinct variety, such as oceanic islands ought to show.

The insects of the Bermudas are but few, and they are all common North American or West Indian species.

The plants number about 300, exclusive of those European and tropical forms which have been introduced by man. Less than half of the 300 are indigenous.

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\* Cape Hatteras is a little less than 600 miles distant from the Bermudas, but the coast trends to the northwest and to the southwest, and Mr. Wallace's statement is substantially correct.

The majority are West Indian, and they are supposed to have been brought to the islands by the Gulf Stream. Those plants which are North American were undoubtedly introduced by the agency of birds.

Seeds are carried by birds in various ways. Very minute seeds are caught in the feathers or under the wings, and so transported; others again, as the seeds of berries and small fruits, remain undigested when the fruit is eaten, and germinate when deposited; and in many cases mud, containing the seeds of grasses and plants, clings to the feet of birds and is borne with them in their flight.

We see, therefore, that two conditions are required for the introduction of plants into an oceanic island by means of birds.

The adjacent continent must have a number of migratory birds, and the ocean between the continent and the island must be stormy, and frequently swept by gales from the land.

The birds and the plants of Bermuda are, as we have seen, almost identical with those of the continent, for the reasons given. With the land shells the case is a little different. One fourth of those found in the islands are peculiar, the whole number being but twenty; and the explanation is that the difficulty in the way of transmission is immensely great in the case of land shells. Terrestrial mollusks reach the islands only by accident, on floating logs, on bits of timber, and sometimes, perhaps, on portions of dams or weirs, established on inland creeks or rivers and borne away to sea by freshets. A species thrown up in this way on those remote islands would remain isolated for an unknown length of time, and undergo modification in its new habitat.

The second group of islands to be considered is the Azores. These islands lie in the North Atlantic, between  $37^{\circ}$  and  $39^{\circ} 40'$  N. Lat., and stretch southeast and northwest, over a distance of 400 miles. The largest of the islands, San Miguel, is about 40 miles long, and the area of the whole group is 700 square miles. It should be noted that the Azores are almost equidistant from the three continents, Europe, Africa, and America, though they are generally classed as African islands. They are of volcanic origin and have frequently suffered from earthquakes and volcanic eruptions; and they present all the marks of volcanic islands—extinct craters, beds of lava broken into friable soil, precipitous mountains, and a dangerous coast. New islands sometimes rise within the group or very near it, and disappear again. The coasts are high and the surface is undulating, with a number of mountain peaks, of which St. Mary's, the lowest, is about 2,000 feet high, and Pico, the highest, not far from 8,000.

The nearest mainland is that of Portugal, to which country the islands belong, and the distance is a little under 900 miles. The ocean lying between is 2,500 fathoms deep. The thousand-fathom line encloses the whole group, but the least depth encountered within 300 miles is 1,800 fathoms. It is not to be supposed, therefore, that these islands were ever united with the European continent; and their volcanic structure makes it incredible that they could have formed part of an Atlantis which included Madeira and the Canaries, the former also volcanic, and the latter a continental group, though volcanic. In all their physical features the Azores come within the strict definition of oceanic islands. In the fauna of the group, the great feature of oceanic islands—



the absence of all indigenous land mammalia and amphibia—is well shown; and there are, furthermore, neither snakes, nor lizards, nor frogs, nor fresh-water fishes. It is true that rats and mice, rabbits and weasels, and a small lizard, which belongs to Madeira and Teneriffe, are now found wild in the Azores, but there is every reason to believe that all these have been introduced by man. The goldfish and eels now found in some of the lakes have the same origin.

Flying creatures, birds and insects, are abundant; and there is also a small European bat.

There are fifty-three species of birds in the Azores; but of these thirty-one are swimmers or waders, birds whose powers of flight are so great that their presence in any island, however remote, is not remarkable. All these aquatic birds are of common European species, and twenty of them are resident in the islands, while eleven are stragglers.

Of the twenty-two land birds, only four are stragglers, the other eighteen being permanent residents. All of these are common in Europe and in North Africa, excepting three, the Atlantic chaffinch and the canary, which inhabit Madeira and the Canaries, and the Azorean bullfinch, which is peculiar to the Azores.

How did these continental birds reach the islands? Mr. Fred. Du Cane Godman, in his "Natural History of the Azores," tells us that, "Hardly a storm occurs in spring or autumn without bringing one or more species foreign to the islands; and I have frequently been told that swallows, larks, grebes, and other species not referred to here are not uncommonly seen at those seasons of the year."

Here again, therefore, we find one of the conditions for the stocking of oceanic islands with animal life, working even at the great disadvantage of 200 additional miles of distance to be overcome. That it works much less effectively in the Azores than in Bermuda is shown by the very much smaller number of species of birds in the former group, 53, as against 180 in the latter. The ratio between these figures would be greatly reduced if the relative areas of the groups were taken into the account, and it is evident that the additional 200 miles of distance act as a very severe means of natural selection, since only exceptionally vigorous birds could survive the buffeting of Atlantic storms for 900 miles. New species may, of course, be added to those already existing; and Mr. Godman has found the wheat-ear breeding in the old crater of the island of Corvo. This is probably a recent immigrant establishing itself.

The birds of the group are most abundant in the islands nearest to Europe and Africa, and this is almost conclusive evidence that they arrived as stragglers. There are three groups in the islands, an eastern one of two islands, a central one of five, and a western one of two. The species diminish in number from the east to the west.

The peculiar bullfinch of the Azores is undoubtedly the result of climatic and other conditions operating through a long period of time. This bird does not migrate and, as it inhabits woody districts, is less likely to be blown out to sea.

The insects, excepting the beetles, are few in number and nearly all of European species. The beetles number 212, and 175 of these are European; but only 74 are

really indigenous, the others having been brought in by man. Twenty-three of the indigenous species are not found in any other of the Atlantic islands and must have been introduced directly from Europe. Only fourteen out of the whole number are peculiar to the Azores. The chances of the same species of insects arriving in the islands are very few, and this fact tends to develop and establish peculiarities; and we find accordingly that while the birds are proportionately more numerous than the beetles, there are very many more peculiar species of the latter.

Among the land shells the number of peculiar species is yet greater than among the insects; and this was to be expected, for the introduction of a mollusk is a rare event, owing to the difficulties in the way of transmission, and a distinct type would soon be developed under the new conditions.

Out of sixty-nine species, thirty-seven are common to Europe, or to the Atlantic islands, and thirty-two are peculiar to the Azores.

The flora of these islands presents 480 species of flowering plants and ferns, and of these 440 are also found in Europe, Madeira, or the Canary Islands, while 40 are peculiar to the Azores. The agencies already named are sufficient to account for the presence of the European and other exotic plants; and it is significant that most of the trees and shrubs with large and heavy fruits are wanting in the Azores. There are no oaks, chestnuts, hazels, apples, beeches, alders, or firs; and the laurestinus, myrtle, Portugal laurel, elder, and other trees or large shrubs found in the islands bear berries, and might, therefore, have been introduced by birds

in one of the ways described. Of the forty species supposed to be peculiar, all but six, which have affinities in the Canaries or Madeira, are allied to European plants.

The almost wholly European character of the Azorean animals and plants leads to the conclusion that what may be called extraordinary and exceptional causes are more potent in the transfer and introduction of forms than the ordinary and more regular causes. The Azores lie in the track of the return southwesterly trade winds and also of the Gulf Stream, and it might be expected that these forces, working steadily in one direction, would fill the islands with American animals and plants, and prevent the introduction of European species. It is the action of the violent storms to which the Azores are subject that has disappointed this expectation, and impressed the European stamp on their fauna and flora.

The Galápagos Islands, the third group we shall examine, differ in important respects from the Azores and the Bermudas. In these we find but a small number of peculiar animals and plants, and we have to note the constant arrival in the Bermudas and, in a lesser degree, in the Azores, of migratory birds and even of insects and plants, brought by the recurring storms of the Atlantic. In the Galápagos the sea and the air are equally undisturbed.

\* These islands, discovered by the Spaniards in the 16th century and named from the numerous *galápagos*, or giant tortoises, which inhabit them, are still not very well known. The group consists of five large and ten small

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\* They were called also the Enchanted Isles—*Islas Encantadas*—because of the strong current and the calms, which made it difficult for ships to approach or to leave them. The Spaniards named also the larger islands, Mascarón, Diablo, Santiago, and others, but the English names have prevailed.

islands, and the total area is estimated at 2,250 square miles.

In the large islands, Albemarle, Chatham, Narborough, Indefatigable, and James, there are mountains of from 3,000 to 4,000 feet in height.

When discovered the Galápagos were uninhabited, and they have remained so to this day, with the exception of two or three penal settlements, kept up by the government of Ecuador. The largest of these settlements, that named La Floreana, on Charles Island, contained at one time 200 or 300 inhabitants, but when the U. S. Steamer "Hassler" visited the group in 1871, there were only about a dozen. Cattle, swine, and goats have been introduced and now run wild.

The Galápagos lie in the Pacific Ocean exactly under the equator, at a distance of about 600 miles from the South American coast; and they are occasionally visited by traders from Guayaquil who collect the *orchilla* for market.

The climate is tempered by the cold Antarctic currents which turn northwest from Cape Blanco on the Peruvian coast and pass through the islands. There is very little rain except from November to January. There is a good deal of low cloud and the nights are misty, but it is only on the higher land, from 800 to 1,000 feet above the sea, that there is any luxuriant vegetation. The low lands are rocky and parched, with a bare growth of stunted shrubs and Peruvian cactus.

The whole group is volcanic, and stands upon a deeply submerged bank, the thousand-fathom line encircling all the more important islands at a few miles' distance, whence there seems to be a steep descent all round to the

average depth of that portion of the Pacific, between 2,000 and 3,000 fathoms.

As in all other oceanic islands, so here we find no truly indigenous mammals; and frogs and toads, the only tropical representatives of the Amphibia, are equally unknown.

Reptiles are, however, represented by the land tortoises, lizards, and snakes. The tortoises are of two peculiar species, one found on most of the islands, and the other but recently discovered on Abingdon Island, from which it has been named. There is also one extinct species. These are all of very large size, and it is thought that they may have been originally derived from the American continent. It does not seem extravagant to suppose, considering the tenacity of life of these animals, that some ancestral form, carried out to sea by a flood, may have been drifted to these islands.

The lizards are five in number—a peculiar species of Gecko, and four species of the American family Iguanidæ. One of these is aquatic and is found in all the islands, swimming at some distance from the shore and feeding on sea-weed.

It is evident that these lizards were derived from the American continent, and at some remote epoch; but how they reached the islands it is impossible to say, though we know that animals of this kind have some means of crossing the sea, since they are found in a considerable number of islands which possess no mammals, nor any other land reptiles.

There are two species of snakes, and this fact is remarkable, because serpents are very rarely found in oceanic islands. Both these snakes are closely allied

to South American varieties, and one is almost identical with a Chilian snake. This fact seems to show that their presence in these islands dates from a comparatively recent period; and it may be accounted for without straining the probabilities. Snakes survive a long time at sea, and an instance is on record of a boa-constrictor that once reached the island of St. Vincent from the coast of South America, a distance of two hundred miles by the shortest route. Snakes are very often found in trees, and might easily be carried long distances if floated out to sea on a tree swept down by a tropical flood or uprooted by an earthquake.

Of birds there are in all fifty-seven species, and of these thirty-eight are peculiar to the Galápagos. Eighteen of the others belong to the aquatic tribes, which are pre-eminently wanderers. The true land birds are thirty-one in number, and all but one are entirely confined to these islands; while more than half of them present such peculiarities that they are classed as distinct genera. They are all allied, and some of them very closely, to birds inhabiting tropical America; while one, the common American rice-bird, is the only land bird identical with those of the mainland. A classification of the birds shows that the diversity between the island and the continental types is greater in proportion to the difficulties and the obstacles in the way of migration. The rice-bird is the only completely unchanged species of land bird in the Galápagos. This bird, which breeds in Canada, swarms over the whole United States, migrates to the West Indies and to South America, visits the Bermudas, distant as they are, almost every year, and ranges as far as Paraguay; and we may conclude that it reaches

the Galápagos often enough and in sufficient numbers to keep up the purity of the breed. The short-eared owl is found here, as it is on the mainland and the continental islands of the Old and the New Worlds.

The more distinct species are allied to non-migratory species peculiar to tropical America; while the distinct genera are allied to South American finches and sugar-birds, which have but a restricted range. The remote ancestral forms of these which reached the Galápagos have remained, therefore, uninfluenced by later migrations and have been developed into a number of distinct types.

The insects of the islands are very few; the beetles, the most plentiful of all, furnishing only thirty-five species, belonging to twenty-nine genera and eighteen families. They are almost all peculiar.

There are about twenty land shells, most of them peculiar species. The currents bring to the southeastern shores of the islands canes, bamboos, drift-wood, nuts of the palm, and other floating objects, and in this way some, at least, of these insects and land shells have been introduced. Besides the waves and the winds, which bring leaves with small insects and eggs of mollusks, there must have been, in islands like these, still subject to volcanic action, an elevation of intervening islands between the coast and the present group, to facilitate the passage of organisms.

The plants of the Galápagos are much more numerous than the known animals, including the insects. There are, in all, 332 flowering plants, 174 of which are peculiar, while 158 are common to other countries. Twenty of these are known to have been introduced by



man. Of the plants which may be called American, 42 are found in North and South America, 21 in South America alone, and 20 in North America and the West Indies.

Sir Joseph Hooker has observed that the plants peculiar to the Galápagos are allied to the plants of temperate America or to those of the high Andes, while the non-peculiar species are such as inhabit the hotter regions of the tropics near the level of the sea. The seeds of this class of plants possess special vitality, and are known to stand long voyages; or they have special means of transport.

One characteristic, and a very significant one, marks the vegetation of these islands. All the plants, without exception, are pale in tone and lack color and beauty; and the flowers are feeble and of a greenish hue. The importance of insects, in the development and vitalization of plants, is nowhere more decidedly shown; for it is impossible not to associate the weakness of the vegetable creation with the scarcity of insects in this group.

In order to arrive at some intelligible theory of the peculiar fauna and flora of these islands, it is necessary to take into account the long-past conditions of sea and land and past changes of climate. The affinities of so many of the plants and of some of the birds in the Galápagos with those of a north temperate and high mountain region point to great changes of climate in the northern hemisphere.

We have seen that in the Bermudas and the Azores the birds are almost exclusively continental and migratory, and that their presence is due to the frequent storms from the direction of the continent; and it is not

difficult to understand why the Galápagos should be far richer in peculiar forms, both of animal and vegetable life, than either of the Atlantic groups considered.

NOTE. *The following communication, made by Mr. D. Morris, of Kew, to NATURE, of Dec. 16, 1886, possesses great value as bearing directly on the main argument of Mr. Wallace's lecture:*

The part taken by birds in the dispersion of plants is one of great interest in view of the difficulty of accounting for the appearance of certain species in remote islands, no less than in localities nearer to each other, or divided by such barriers as mountain ranges or deep seas. This subject has, more or less, engaged the attention of botanical travellers from the time when Darwin published his classical "Journal of Researches," nearly fifty years ago, down to the publication of Mr. Hemsley's "Botany of the *Challenger* Expedition," part 1, which was issued as lately as last year. In the careful summary of plants probably distributed by birds, *loc. cit.*, pp. 44-49, it is mentioned that seeds may be carried by birds in either of two ways: First, by seeds, especially those provided with barbs and hooks, attaching themselves to the feathers of birds, and in the case of aquatic or burrowing birds being embedded in mud and thus carried accidentally outside; or, secondly, by seeds swallowed by frugivorous birds being for a time lodged within, and dejected afterwards in such a state as to be capable of germination. My object now is not to treat generally of this subject, but to place on record two remarkable and striking instances where seeds carried and

dispersed by birds have come immediately under my own observation. The examples which I shall here describe will, I believe, show clearly that birds are capable of acting as very effective agents in the dispersal of plants, and that the results are so apparent as to be placed beyond reasonable doubt. In cases where seeds of a light character are provided with barbs or hooks, they are well adapted for attaching themselves to passing objects, and are most favorably placed for dispersal by means of birds. The particular plant with barbed seeds which I described under this category has not, I believe, been mentioned before; but it is deserving of notice, as it fully meets all the requirements incidental to this form of dispersal, and, moreover, I have had, for some years, very favorable opportunities of observing its behavior. This plant is *Uncinia jamaicensis*, Pers. (*Cyperaceæ*), which grows in damp places in the mountains of Jamaica, at elevations of 5,000 to 6,000 feet. It is generally found overhanging small pools of stagnant water or on banks of mountain rivulets. Its slender tapering spikes, when ripe, literally bristle with long exserted rachilla, each shaped something like a shepherd's crook (hamate), but with the hooked part so closely fitting and elastic that, if drawn along the back of the hand, it would grasp and draw out the finest hairs.

Now, such places as are affected by this *Uncinia* are also the frequent resort of numerous birds that come there to drink, or bathe, or to seek coolness and shade. In the case of migratory birds, and especially those that cover long distances in their flight, the high lands are generally those first touched. This is doubtless owing to the elevation at which they fly to escape surface currents

or local objects. I have often noticed birds from the North (the United States) on their way South, and again birds from the South returning to the North in early spring, frequenting the highlands of Jamaica, and resting there for a time before continuing their journey. Some such birds have been easily caught by hand, so exhausted were they with their long flight. In two instances I have found small migratory birds so completely entangled in the hooks of the *Uncinia* (*Gardeners' Chronicle*, 1881, p. 780) that they were unable to extricate themselves; and, unless set at liberty at the time, would probably have died in that situation. In these instances the hooks of the *Uncinia* overstepped their proper function; for, obviously, no benefit would arise to the plant from the death of the birds, but only in the removal of the seed to another place. Larger birds, of course, would not be caught; but on the other hand, if they came within reach of the *Uncinia*, they could hardly get away without detaching a large number of the fruits and transporting them wherever they went. In the case of the *Uncinia*, there is present nearly every condition necessary to secure a very complete dispersion of its fruits. The plant, in the first place, is possessed of light portable seeds easily carried about from one locality to another; in the second place, the seeds are provided with highly specialized hooks which effectually grasp any thing that comes within their reach; and lastly, the plant affects just those places which are visited by birds, and seldom fails to secure a sure and trusty carrier. It follows, as a matter of course, that *Uncinia jamaicensis* is found plentifully distributed in the track of migratory birds, and is found in similar situations in the mountains.

on the mainland in Central America, Venezuela, Ecuador, etc. So much for seeds with barbs and hooks.

We now come to the second class of seeds, namely, those which are swallowed by frugivorous birds, and dejected in a state suitable for germination. The most striking examples I know of the dispersion of such seeds, and of the results which immediately follow, are shown in connection with the pimento industry of Jamaica, which, as shown below, depends entirely for its existence on the offices of frugivorous birds. The pimento of commerce is the dried fruit of the pimento allspice, or Jamaica pepper tree (*Pimenta vulgaris*). No other country supplies this article, although the tree itself is widely distributed both in the West Indies and on the mainland, and the value of the exports of pimento from Jamaica has reached (in 1880) a total of £100,000. This is probably the largest spice industry in the world, and to repeat what is mentioned above, it is wholly dependent upon the action of frugivorous birds. In Lunan's "Hortus Jamaicensis," vol. ii., p. 67, published about the end of last century, it is stated that "the usual method in forming a new pimento plantation or 'pimento walk' is nothing more than to appropriate a piece of woodland in the neighborhood of a plantation already existing; or in a country where the scattered trees are found in a native state, the woods of which being fallen, the trees are suffered to remain on the ground till they become rotten and perish. In the course of twelve months after the first season's rains, abundance of young pimento plants will be found growing vigorously in all parts of the land, being without doubt produced from ripe berries scattered there from the birds, while the fallen trees, etc.,

afford them both shelter and shade." In a foot-note it is added that "birds eagerly devour the ripe seeds of the pimento, and, muting them, propagate these trees in all parts of the woods. It is thought that the seeds passing through them undergo some fermentation which fits them better for vegetation than those gathered immediately from the tree." The present plan for forming pimento plantations in Jamaica is exactly as described above. In fact, the planters firmly believe that no other plan is likely to produce good pimento walks, although it has been shown by experiments in the Botanical Gardens that by careful treatment plants of pimento can be raised in nurseries in large numbers, exactly as any other economic plants. It remains, however, that all the present pimento plantations in Jamaica have been formed by the action of frugivorous birds, and to this agency alone we are indebted for the commercial supply of a most valuable and wholesome spice.